Review Article

Relation between Socioeconomic Indicators and Children Dental Caries in Iran: A Systematic Review and Meta-analysis

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Abstract

The relationship between households' socioeconomic situation (SES) and children dental caries has been assessed in many Iranian studies to evaluate the effect of public dental care programs supporting the poor. Hence, this study through systematic review and meta-analysis has presented a conclusion in this regard. Domestic and foreign databases were searched using keywords designed by concept map. Time limit to search the databases included articles published from 1994 to 2017. Twenty-five articles were entered to the final step of the study, in which 49 relationships between SES and dental caries were assessed. Heterogeneity between studies was assessed using I^2. Publication bias has been assessed using funnel plot and Egger's test. The data were assessed by STATA 13.1. Odds ratio and mean difference of children dental caries in high SES households in comparison with low SES households were 0.41 (confidence interval [CI]: 0.30, 0.52) and −0.49 (CI: −0.85, −0.13), respectively. The CI in both cases did not include "null or no effect line," so there was a significant inverse relation between SES and dental caries. Despite the emphasis on upstream documents on equity in access to dental health services, there was high difference between SES groups in this regard. It is necessary to revise dental health programs at the country level to decrease these differences.

Keywords: *Dental caries, Iran, meta-analysis, socioeconomic factors*

Introduction

Dental caries is one of the most prevalent childhood diseases, especially in the developing countries.[1] Untreated dental caries lead to problems in eating and sleeping, pain, need to invasive restoration treatment, emergency dentistry visit, hospitalization, low quality of life (QoL), systemic health problems and in rare cases leads to death,[2,3] however treatment for dental diseases is costly especially for poor and low income families.[4] Dental caries prevalence has had a decreasing trend in the past decades both in developing and developed countries, but it has a high prevalence in low socioeconomic families of all these countries.[5,6]

Many studies have been performed in different cities of Iran about the relation between the households' socioeconomic situation (SES) and children dental caries [Table 1]. However, it is not specified to what extent different socioeconomic parameters such as education level, income, and job have a significant relationship with generating caries lesions or caries experience. In other words, the situation of this relation is not specified for Iran, totally. Hence, it is necessary to study first the existence and second the severity of this relation.

This is while a great importance has been paid to the health care and equity in access between the poor and the rich by upstream documents, including Iran's 20-Year Development Vision (2005–2025) and also Articles 3, 29, and 43 of the Constitution of the Islamic Republic of Iran.[7,8] In a national program, dental health services have been integrated into the Iran healthcare network in 1994 to improve the access of deprived people to the dental services.[9] The latest national program to support the poor was Health Sector Evolution Plan (HSEP) by the 11th Iran government in 2014. Among the most important goals of the HSEP are providing health insurance for all Iranians, improving suburban regions access to health services, and increasing people health literacy.[9] Therefore, public health care has been emphasized in upstream documents. By attention to high importance given by the upstream documents to the

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Table 1: Concept map and designed keywords for search in different databases

Population	Intervention	Outcome	Time period
Iran	Education*	dmfs	1994-2017
	Income	dmft	
	Occupation*	Caries	
	Socioeconomic*	Carious	
	Social	dmf	
	Economic	Decay	
	Economical	Decayed	
	School	"Oral"	
	University	Dental	
	Finance	Orodental	
	Financial	Deciduous	
	Inequit*	Dentition	
	Inequal*	Gingivitis	
	Access	Periodontics	
	Accessab*		
	Accessib*		
	Accessing		
	Utilization		
	Pocket		
	Pockets		
	Quality of life		
	Risk factor		
	Poverty		

healthcare, this systematic review and meta-analysis study has been designed to assess the children caries situation in terms of their households' SES.

The aim of this study is to assess the probable relationship between SES of Kerman city households and their children dental caries. Such a study can fill the gaps and weaknesses in present knowledge and methods, and also, it can be possible to assess the impact of confounders such as the study type, its quality, and the size and age of the population on the relationship severity.

Methods

All of epidemiological studies including cross-sectional, case–control, cohort, and clinical trials in all age and sex groups were eligible to enter the study. The specified question of this study was: Is there a significant relationship between caries and households' SES? The purpose of SES is each type of relationship with education in school or university, type of job, and income level.

The Global Burden of Diseases Study in 2010 has defined dental caries as "teeth with unmistakable coronal cavity at dentine level, root cavity in cementum that feels soft or leathery to probing, temporary or permanent restorations with a caries lesion."[10]

Search strategy to obtain related studies

The Iranian databases of Scientific Information Database (http://sid.ir/), Barakat Knowledge Network System (http://www.barakatkns.com), and foreign databases of Scopus (www.scopus.com), Web of Science (http://www.isiknowledge.com), Google Scholar (https://scholar.google.nl/), PubMed (http://www.ncbi.nlm.nih.gov/pubmed), and EMBASE (https://www.embase.com) were searched systematically. There was no limitation about the searched languages in databases. Dental care services were integrated into Iran healthcare networks in 1994 to dental health services could be accessible for all.[11] Hence, the history of Iran dental services could be divided into before the integration and after it. Therefore, time period for search in databases considered from 1994 to 2016.

After breaking the project topic into keywords which indicate the main concepts of the study, using brainstorm, the alternative keywords that any authors may have used in their articles were determined. Accordingly, the concept map and keywords for search in different database are shown in Table 1. As explained in the findings, only observational studies entered into the current study, so it is not possible to define all of PICOT components (Population, Intervention, Comparison, Outcome, Time duration) to search in scientific databases.

The process of building a search query for each column was determined, and after completing each column, they were combined with each other to generate the final search query. As an example, the final search query for PubMed database is as below:

((((((((((((((((caries) OR periodontics) OR gingivitis) OR dentition) OR Deciduous) OR orodental) OR dental) OR "Oral") OR decayed) OR decay) OR dmf) OR carious) OR dmft) OR dmfs)) AND ((((((((((((((((((((access) OR pocket) OR pockets) OR poverty) OR risk factor) OR quality of life) OR utilization) OR accessing) OR accessib*) OR accessab*) OR inequal*) OR inequit*) OR financial) OR finance) OR University) OR School) OR economical) OR economic) OR social) OR socioeconomic*) OR occupation*) OR income) OR education*))) AND Iran.

Other databases were searched on the basis of their search guidance, too. Moreover searching electronic databases, reference lists of retrieved articles, related books, organizations and government guidelines, and websites were searched. Furthermore, we communicated with authors of published and unpublished articles, theses, conference reports, and so on to obtain more information about their projects.

Study selection

First and second authors independently performed full work of searching the mentioned databases, including search and extract articles, assessment validity, and duplications. Characteristics of the final retrieved articles were entered into EndNote X8, Thompson Reuters.

After reading title and abstract, unrelated articles excluded from the study cycle. The excluded studies

were archived along with the reason of rejecting. Calibration exercise was 10% so that to determine inter-examiner agreement, authors 4, 5, and 6 read 10% of the articles ($\kappa = 0.85$).

The criteria for including were studies in 6–65 years old, reporting risk factors for dental caries, especially socioeconomic factors (although socioeconomic factors were not their main goals), studies conducted in national or provincial or city levels of Iran published in local and international prestigious journals, studies with random samples, response rate more than 50%, and attrition rate lower than 50%. The criteria for excluding studies were letter to editor, editorials, grey literature, case studies, studies before 1995 (because new era in Iran dental health started in 1995), studies about caries in persons with other diseases such as cancer, diabetes, studies in special groups such as pregnant women and studies about water fluoride, educational programs, diagnostic and laboratory studies, and dental services consent.

Data extraction

The main characteristics of the included studies were extracted using the second and third authors. For this, a pilot-tested spreadsheet was developed and the studies information including authors, year of publication, study design, place of study, location of data collection, study population, subjects' years of old, dependent variable, SEP parameter, low SEP, high SEP, effect measure, effect estimate, and Newcastle Ottawa scale (NOS) was extracted.

Quality assessment

Articles with primary requirements which were included in data extraction were further assessed for quality using Newcastle-Ottawa Quality Assessment Scale (NOS).[12] Authors number 1 and 5 assessed the quality of studies using this scale. In this scale, (1) selection of the study population has 0–4 items, (2) comparability of subjects has 0–2 items, and finally, (3) outcome for cohort and cross-sectional studies has 0–3 items. Each study receives 1 point per each item. For part 1, the items include representativeness of the exposed cohort, selection of the unexposed cohort, ascertainment of exposure, and demonstration that the outcome of interest was not present at the start of the study. For part 2, the items include comparability for core factors and comparability for additional factors, and for part 3, the items include assessment of outcome, sufficient duration of follow-up for the outcome to occur, and adequacy of follow-up of cohorts.

The maximum number each study can obtain from NOS is 9 (4 + 2 + 3). If a study obtains score 7 or above, it has high quality. Studies with scores between 5 and 7 have moderate quality and studies with score lower than 5 have low quality.

Statistical methods

To make possible the comparison between the studies, the highest and the lowest SES extracted from each study, the lowest SES was considered as the reference. Risk estimate was extracted from each study, and if one study has not reported risk estimate, we extracted it using raw data in that study.

The significant relationship between SES and dental caries both in odds ratio (OR) studies and mean difference (MD) studies was interpreted based on their situation from vertical line (or no effect line or null line) in forest plots. This line means that there is no relation between independent and dependent variables. Relative statistics such as OR has a null effect value equal to 1 and absolute statistics such as MD has a null effect value equal to 0. If the confidence interval (CI) of each study touch the vertical line (1 for OR and 0 for MD), the result is not statistically significant.[13,14]

The studies heterogeneity assessed using I^2 index. Because of expecting heterogeneity both between and within studies, random-effects model was used.

The publication bias assessed using funnel plot and Egger's test. Funnel plots are used when there are more than 10 studies. If there is no publication bias, the funnel plot turns upside down or become inverted. The considered index locates on the horizontal axis and its standard error (SE) on the vertical axis. The larger the size of the study, the greater its precision and its effect measure locates higher in the funnel plot and vice versa for smaller studies. In addition, the estimates of smaller studies are away from each other in the bottom of the graph and the estimates of larger studies are close to each other at the top of the graph, so the graph inverts to a funnel-shaped plot.

Statistical power of the Egger's test in indicating publication bias is higher than Begg's test. Hence, to interpret the funnel plot statistically, we used Egger's test. If there is no publication bias in meta-analysis, its Egger's test should become insignificant statistically and its CI should include zero number.[15] The data analyzed using Stata software, Stata 13.1 (Stata Corp, College Station, TX, USA).

Results

By attention to the required different methods of search in scientific databases, the procedure of article selection in these databases is described here.

PubMed

After searching search strategy in PubMed with filters of the year (from 1995 up to now), study on human beings, and search in title/abstract, 244 articles were retrieved. After removing unrelated studies such as studies on diabetic, asthma, dialysis and hepatitis patients, also knowledge and attitude studies, and after studying the articles full text, 16 articles were identified and were entered into the EndNote software.

Web of Science

After defining search strategy and period, 454 articles were retrieved. Then, after the articles were refined on the basis of categories, document type, and search in the researchers' desired fields, 205 articles were obtained. In the next step, by studying the abstract and full text of articles, 14 studies were obtained finally and were entered into the EndNote software.

EMBASE

After writing search strategy in EMBASE database, 493 articles were retrieved. The articles were decreased to 74 by implementing filters on study year and type and by studying the titles, abstracts, and full texts, nine articles were remained finally and were entered into the EndNote software.

Scopus

The first searches in Scopus in documents part and by putting "or" and "and" between the keywords and applying limitations on date range and document type yielded 994 articles. After studying the title of the article, those in other subject areas were removed. At the final step by studying the abstract and full texts, 14 articles were remained and were entered into the EndNote software.

Barakat Knowledge Network System

The search process in this scientific database led to 32 articles, and after reading the titles, 16 articles remained, and finally, by reading the abstracts/full texts, 12 articles were remained and were entered into the EndNote software.

Scientific Information Database

The search process in this scientific database led to 118 articles, which after removing unrelated articles, 15 cases entered into the EndNote software.

So, the final articles entered to the EndNote were 80 articles (16 for PubMed, 14 for Web of Science, 9 for EMBASE, 14 for Scopus, 12 for BKNS, and 15 for SID). After deleting the duplicate articles, 25 articles remained finally.

Studies characteristics

After the above final retrieved articles were entered into the EndNote software and by removing the duplicate articles, 25 articles (in which 49 relationships between SES and dental caries were assessed) were entered to the final step of the systematic review and meta-analysis. The total number of the participants in these studies was 78,434 persons. The studies quality assessment using NOS indicated that their NOS located between 3 and 6, so the studies had low to moderate quality.

These 25 articles had assessed the relationship between SES and dental caries in two ways. The first groups had mentioned A (healthy exposed), B (patient exposed), C (unhealthy exposed), and D (patient unexposed) cases in their studies, which we could extract OR from them using the order of "case–control OR calculator" in Stata software. The second groups had mentioned mean dental caries and its 95% CI along with SES of the households, in which MD was derived by decreasing mean dental caries in households with high SES than households with low SES using the order of "effect size based on mean comparison" in Stata software. By attention that all retrieved studies were cross-sectional, so the type of study has not been stated in Table 2.

Subgroup and overall summary of the relationship between socioeconomic situation and dental caries

The relationship between household socioeconomic situation and dental caries in the studies when odds ratio was extractable

Figure 1 indicates that the OR of the relationship between households' income and children dental caries is 0.12 (CI: −0.14, 0.38). This CI does not include no effect line (or null line), so there is an inverse significant relationship between household income and dental caries. In other word, dental caries decreases 0.88 by increasing household income.

The OR of relationship between mother education and children dental caries is 0.14 (CI: 0.07, 0.21) which does not include no effect line, so dental caries decreases 0.84 by increasing mother education which is significant statistically.

The OR of the relationship between mother job situation and children dental caries is 0.60 (CI: 0.40, 0.80). This CI does not include no effect line, so it is significant statistically so that employed mothers with a probability of 0.40 have children with lower caries rate than others.

The OR of the relationship between father education situation and children dental caries is 0.55 (CI: 0.24, 0.86). This CI does not include no effect line, so it is significant statistically so that employed fathers with a probability of 0.45 have children with lower caries rate than others.

The OR of the relationship between SES and children dental caries is 0.63 (0.36, 0.90). This CI does not include no effect line, so it is significant statistically so that the OR of dental caries in children belonging to higher SES households' is 0.37 lower than other households.

Finally, the OR of the relationship between father job situation and children dental caries is 0.25 (CI: −0.04, 0.54). This CI does not include no effect line, so it is significant statistically, and the probability of dental caries in children with employed fathers is 0.75 lower than other children.

Overall, the OR of the relationship between all SES indices and children dental caries is 0.41 (CI: 0.30, 0.52). This CI does not include no effect line so that the OR of children dental caries in higher SES households is 0.59 lower than the children belonging to low SES households.

Table 2: Characteristics of cross-sectional studies included in the systematic review and meta-analysis

Author, year	Province, city	Location data collection	Sampling method	Number of samples	Caries index	SEP	Low SEP	High SEP	Effect estimate	Effect measure
Meamar *et al.* 2000[16]	Sanandaj, Kordestan	Schools	Classified random sampling from 12-year-old students	439	DMFT	Family income	<135 US$	>378 US$	0.08 (0.02-0.31)	OR
Toomarian *et al.* 2005[17]	Qom, Qom	Schools	Multi-stage randomized sampling of 12-year-old students	300	DMFT	Mother education	<Lower diploma	>Higher diploma	0.4 (0.16-0.92)	OR
Abedini *et al.* 2013[18]	Kashan, Isfahan	Health centers	2-stage randomized sampling of 2-6-year-old	310	Caries	Mother job, mother education, father education	Housewife, illiterate, illiterate	Employed, >BS, >BS	0.78 (0.41-1.48) 2.19 (0.97-4.9) 1.46 (0.68-3.16)	OR
Vejdani *et al.* 2006[19]	Talesh, Gilan	Health centers	Multi-stage randomized sampling of 2-4-year-old	261	Caries	Mother education, father education	Illiterate, illiterate	Excellent, excellent	0.24 (0.04-1.03) 0.12 (0.01-0.61)	OR
Toutouni *et al.* 2015[20]	Tehran, Iran	Health centers	Stratified cluster random sampling of 2-3-year-old	239	Caries	SES	Low	High	0.58 (0.21-1.57)	OR
Eskandarizadeh *et al.* 2015[21]	Kerman, Kerman	Schools	Multi-stage random sampling of 6, 12, 15-year-old	15,369	Caries	Father education, mother education	Illiterate, illiterate	University, university	0.77 (0.68-0.88) 0.077 (0.067-0.088)	OR
Faezi *et al.* 2012[22]	Tehran, Tehran	Schools	Multi-stage random sampling of 6-12-year-old	820	DMFT	Mother education, father education	Under university, under university	University, university	0.09 (0.06-0.14) 0.34 (0.22-0.50)	OR
Hematyar and Masnavi 2009[23]	Tehran, Tehran	Hospitals	All 3-7-year-old referring to hospitals	200	Caries	Mother education, SES	<Diploma, low	University, high	0.21 (0.1-0.4) 0.42 (0.17-1.03)	OR
Javadinejad *et al.* 2007[24]	Isfahan, Isfahan	Schools	Exposure and control groups, 12-year-old	340	Caries	Father education, mother education, mother job	Elementary, elementary, unemployed	University, university, employee	0.2 (0.02-1.13) 0.45 (0.15-1.33) 0.86 (0.18-3.87)	OR
Mehrabkhani *et al.* 2014[25]	Mashhad, Razavi Khorasan	Well-being centers	All 6-year-old children	143	Caries	Income	<54 US$	54-135 US$	0.55 (0.12-1.82)	OR
Seyed Akhavan *et al.* 2004[26]	Karaj, Alborz	Schools	Multi-stage random sampling of 12-year-old	768	DMFT	Mother job, SES	Household, weak	Employed, >average	0.55 (0.31-0.98) 0.82 (0.52-1.31)	OR

Contd...

Table 2: Contd...

Author, year	Province, city	Location data collection	Sampling method	Number of samples	Caries index	SEP	Low SEP	High SEP	Effect estimate	Effect measure
Jahani *et al.*, 2013[27]	Kerman, Kerman	School	Stratified cluster random sampling	906	dmft/ DMFT	Mother education, father education, mother job, father job	<High school, <high school, household, household	University, university, employed, employed	0.9 (0.5-1.5) 1.11 (0.7-1.69) 0.58 (0.37-0.92) 0.25 (0.1-0.68)	OR
Soufi *et al.* 2011[28]	Hamedan, Hamedan	Schools	Stratified cluster sampling of 13-19-year-old	398	DMFT	Father education, mother education	<High school, <high school	>BS, >BS	−0.92 (−1.32-−0.52) −0.94 (−1.34-−0.53)	Mean difference
Shamsi *et al.* 2013[29]	Arak, Markazi	Health centers	Stratified cluster random sampling of pregnant women	340	DMFT	Family income, SES	Low, zone 1	High, zone 3	−0.63 (−0.93-−0.32) −1.12 (−1.39-−0.83)	Mean difference
Sajadi *et al.* 2014[30]	Sirjan, Kerman	Schools	Cluster random sampling of 12-year-old	700	DMFT	Mother education	Illiterate	>doctoral	0.029 (−0.22-0.028)	Mean difference
Saied-Moallemi *et al.* 2006[31]	Tehran, Tehran	Schools	Multi-stage stratified random sampling of 9-year-old	459	Boys dt, girls dt, boys DT, girls DT	Parent education	Low	High	−0.46 (−0.84-−0.079) −0.39 (−0.75-−0.024) −0.17 (−0.54-0.20) −0.44 (−0.81-−0.073)	Mean difference
Rigi Ladez *et al.* 2012[32]	Sistan and Baluochestan	Population	Random stratified clustering of 35-44-year-old	550	DMFT	Education, income	Illiterate, low income	University, high income	−0.10 (−0.45-0.25) −0.04 (−0.41-0.34)	Mean difference
Pakpour *et al.* 2011[33]	Qazvin, Qazvin	Schools	Stratified cluster sampling of 14-18-year-old	380	Caries	Income, education	Low income, SES zone 1	High income, SES zone 2	1.41 (1.10-1.71) 0.42 (0.17-0.67)	Mean difference
Momeni *et al.* 2006[34]	Tehran and rural Isfahan	Schools	Random sampling of 12-year-old	1102	DMFT	SES	Low	High	−0.46 (−0.62-−0.30)	Mean difference
Nabipour *et al.* 2013[35]	Varamin, Tehran	Kindergarten	Census, 3-6-year-old	838	dmft	SES	Low	High	−0.16 (−0.34-0.02)	Mean difference
Nematollahi *et al.* 2009[36]	Birjand, South Khorasan	Kindergarten	Random sampling of 13-72-month-old	434	dmfs	Father educations, mother education	Elementary, elementary	>MS, >MS	−0.77 (−1.22-−0.32) −1.10 (−1.73-−0.46)	Mean difference

Contd...

Table 2: Contd...

Author, year	Province, city	Location data collection	Sampling method	Number of samples	Caries index	SEP	Low SEP	High SEP	Effect estimate	Effect measure
Kazerouni *et al.* 2005[37]	Tehran, Tehran	Schools	Multi-stage random sampling of 8-year-old	1024	Caries	Father job, SES	Unemployed, division 1 and 2	Manager, division IV, V	−1.62 (−2.13–−1.10) −0.92 (−1.13–−0.72)	Mean difference
Hessari *et al.*, 2007[38]	Iran	Population	Stratified cluster random sampling of 35-44-year-old	8301	Caries	Men education, women education	Illiterate, illiterate	High, high	−0.31 (−0.44–−0.18) −0.33 (−0.49–−0.18)	Mean difference
Hessari *et al.*, 2008[39]	Iran	Population	Stratified cluster random sampling of 15-19-year-old	4448	Caries	Men education, women education	Low, low	High, high	0 (−0.15-0.15) −2.2 (−2.3–2.1)	Mean difference
Basir *et al.*, 2014[40]	Ahvaz, Khuzestan	Kindergarten	Randomized classified sampling of 3-6-year-old	322	Caries	Father education, mother education	Elementary, elementary	>MS, >MS	−0.73 (−1.08–−0.38) −0.44 (−0.82–−0.05)	Mean difference

DMFT=Decayed, missing and filled teeth, BS=Bachelor of Science, MS=Master of Science, SES=Socio-Economic Situation

The relationship between household socioeconomic situation and dental caries in the studies when mean difference was extractable

Figure 2 indicates that the amount of MD between father education and children dental caries is-0.82 (−1.77, 0.13). This CI has included no effect line to a small amount. Hence, although only one study among five has rejected this relation and others are inverse significant statistically, this relationship is not significant.

The MD of the relationship between mother education and children dental caries was −0.49 (CI: −0.86, −0.12). This CI has not included no effect line so that by increasing mother education, dental caries decreases significantly.

The MD of the relationship between household income and children dental caries is 0.25 (CI: −1.02, 1.51). This CI has not included effect line, so there is no significant relationship between household income and dental caries.

The MD of the relationship between household SES and children dental caries is −0.45 (CI: −0.90, 0.01). This CI has included no effect line in a small amount. Hence, although the most of studies in this subgroup approve this relationship, the final analysis does not approve such a relationship.

The MD of the relationship between parents' education and children dental caries is −0.31 (CI: −0.47, 0.14). This CI has not included no effect line so that by increasing parents' education, children dental caries decreases significantly.

The MD of the relationship between father employment and children dental caries is −1.62 (CI: −2.63, −1.11). This CI does not include no effect line, so this relation is significant statistically. In other words, dental caries in children with employed fathers is lower than others, significantly.

Overall, the MD of the relationship between all SES indices and children dental caries is −0.49 (CI: −0.85, −0.13). This CI does not include no effect line so that by improving household SES, children dental caries decreases, significantly.

Publication bias

Funnel plot of the relationship between household SES and dental caries in studies which OR was extractable is indicated in Figure 3. The standard error is plotted against OR. An asymmetric funnel plot indicates low level of publication or small-study bias, further supporting the reliability of the overall findings. Further, publication bias was not approved using Egger's test, because first its test is not statistically significant ($P>|t|=0.374$) and second its CI includes zero (−1.96, 5.01).

Funnel plot of the relationship between household SES and dental caries in studies which MD was extractable is indicated in Figure 3. The standard error is plotted against MD. An asymmetric funnel plot indicates low level of

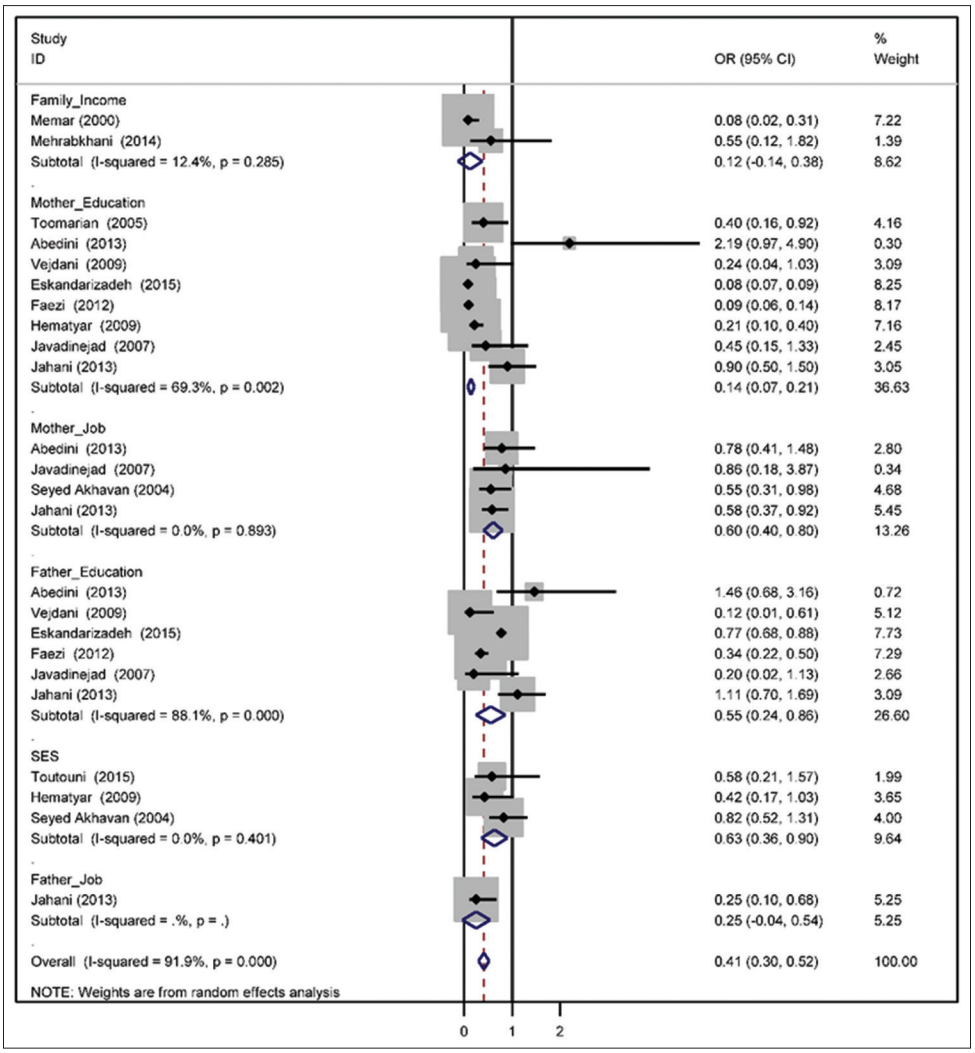

Figure 1: Forest plot of the relationship between household socioeconomic situation and children dental caries based on odds ratio index (with 95% confidence interval in terms of author name and research year)

publication or small-study bias, further supporting the reliability of the overall findings. Further, publication bias was not approved using Egger's test, because first its test is not statistically significant ($P>|t|=0.254$) and second its CI includes zero (−2.91, 10.48) [Figure 4].

Heterogeneity rate in the studies that had assessed the OR and MD of the relationship between SES and children dental caries was 91.9 and 98.4, respectively [Tables 1 and 2]. I^2 index lower than 25%, between 25% and 75%, and higher than 75% considered as low, medium, and high heterogeneity respectively, so the heterogeneity rate in this study was high. Therefore, random effect model used to analyze the articles.

Discussion

Systematic review and meta-analysis of the relationship between household SES and children dental caries were studied in this study. As results indicated, OR of children dental caries in high SES households in comparison with low SES households is 41% (CI: 0.30, 0.52). Because this CI does not include null or no effect line (1 line) and also the OR is lower than 1, so there is an inverse significant relationship between SES and children dental caries. Further, the results indicated that MD of children dental caries in high SES households in comparison with low SES households is −0.49 (CI: −0.85, −0.13). Because this CI does not include null or no effect line (zero line) and also the MD is lower than 0, so there is an inverse significant relationship between SES and children dental caries.

The articles used in this study were different in terms of study design and methods used to assess dental caries and SES and had high level of heterogeneity. For example, the authors of these articles have used different indices such as DMFT, DMFS, caries, and caries free. In addition, the effect of confounders of the relationship between SES factors and dental caries has not been controlled. However, most of the articles have approved the significant inverse relationship between these indicators. Further, the number of studies was favorable so that 25 articles were entered to

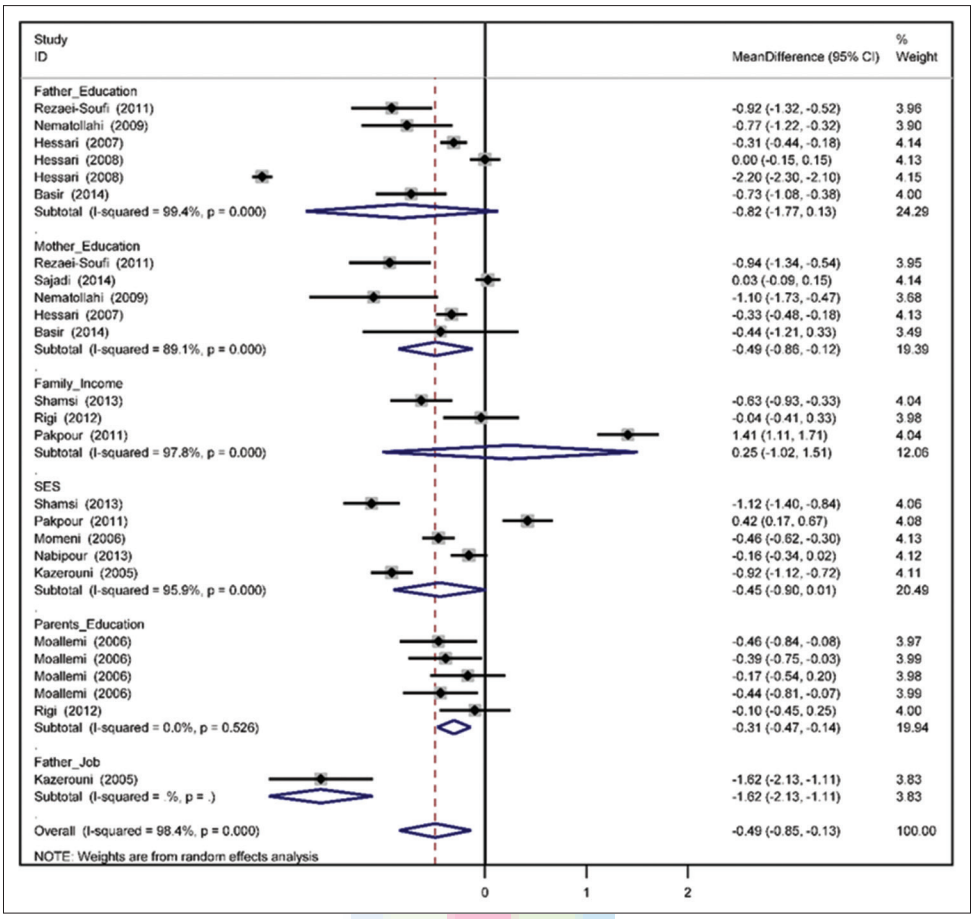

Figure 2: Forest plot of the relationship between household socioeconomic situation and children dental caries based on mean difference index (with 95% confidence interval in terms of author name and research year)

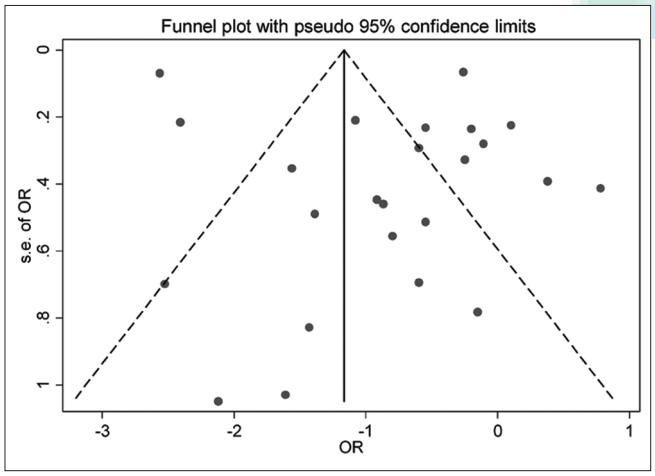

Figure 3: Funnel plot indicating publication bias for odds ratio studies

the final step of the study, which totally have assessed 50 relationships between the indicators.

The inverse relationship between parents' education level and children dental caries was significant in this study. Studies in other countries support this finding. The children with higher mother education level had lower dental caries.[41] Further, there was a significant inverse relationship between father education level and dental caries in Greece and Libya.[42,43]

The households who have higher education levels usually have higher income level and better access to the dental services, also use preventive dental services more than others, and prevent harmful foods.[44] In addition, parents with high level of education are probably more interested and responsible for health issues such as maintaining good diets and hygiene, so their children have more healthier teeth.[45]

Overall, different studies have confirmed that the children with low-level education parents and low family incomes have more dental caries.[46,47] In this study, there was a negative significant relationship between household income and dental caries in OR articles, but this relation was not significant in MD articles. In other words, among seven articles that had assessed the relation between income and dental caries, only two articles[32,33] have reported that there is a direct and significant relationship between income and dental caries which is in contradiction with studies abroad. The logic of these articles is that first high-income families can buy more sweets and snacks than others which is a contributory factor in creating dental caries[33] and second different income levels may not have a significant effect

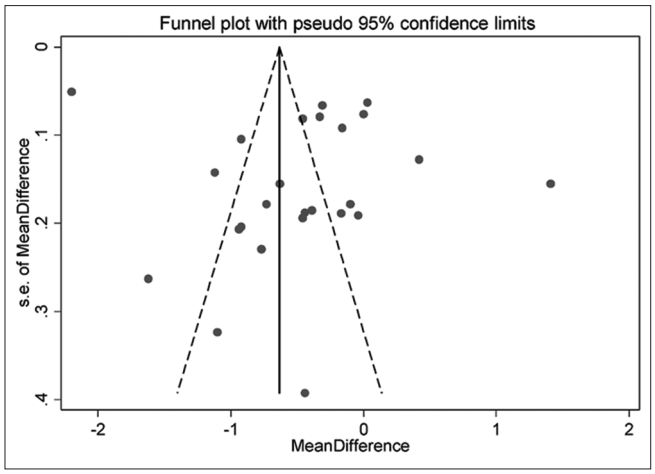

Figure 4: Funnel plot indicating publication bias for mean difference studies

on dental health behaviors; moreover, some families may not express their real monthly income.[32] However, as mentioned, there was a negative significant relationship between household income and dental caries in other studies. One of the reasons is that low-income families consume foods that are low in nutrients and high in sugar and fat, so their children are more susceptible for dental caries.[48] Furthermore, low-income families less visit a dentist and do less preventive and curative measures.[49]

There was an inverse significant relationship between parents' employment situation and their children dental caries. A study in India indicated that children with unskilled mothers or housewives have dental caries twice more than children with skilled or employed mothers.[50] Moreover, a study on Belgium children indicated that dental caries decreased as mothers' occupational level increased. However, studies in Japan, Brazil, and Mongolia indicated that there was no significant relationship between mother employment status and children dental caries.[41,45,51] Positive and significant relationship between mother employment status and dental caries may be because of increasing household income when mother is employed and therefore higher access to dental services. On the other hand, no significant relation between mother employment status and children dental caries in other mentioned studies may be because of development of dental health system which provides the needed services for all of population regardless of mother employment status, household income, or other variables.

Overall, there was an inverse significant relationship between households' SES and children dental caries in the current study. A systematic review on 272 articles indicated that children belonging to low SES families have higher dental caries prevalence in comparison with low SES families.[52] Hence, the negative relation between SES and dental caries in countries with undeveloped and noncomprehensive dental health system, which people do not have access to the services irrespective of their SES, is a proven fact.

The services delivered by public sector do not include lower socioeconomic groups thoroughly or do not have required effectiveness. A study in Iran indicated that dental care costs have been an important factor in creating catastrophic costs in Iranian families. Further, low-income families because of low utilization of dental care services have been less exposed to the catastrophic costs.[53] Public preventive dental programs such as water fluoridation are one of the best ways to reduce current inequalities. In addition, Iran ministry of health should avoid excessive concentration on costly and specialized dental services and consider people as patients, not customers.[54]

In this regard, the governments and insurances have the main role. Currently, the situation of dental services coverage is not equitable and the poor should pay a large proportion of their low income on dental services. On the basis of Iran Dental Association, total dental costs have been 97 million US$ in 2011, in which only 11% has been financed by insurance system and the share of out of pocket costs has been 89%. Hence, dental insurance coverage has not been provided for considerable part of the population. By attention that the costs of dental complemental insurance are paid by employers or nongovernmental public sector, so the share of government contribution to dental costs is practically nothing.[55]

Dental services have been included in the package of Iran health insurances, but only examination, radiography, extraction, molar surgery, dental health education, scaling and filling for 6–12 years old children are covered. Two main Iran insurance funds (i.e., social security and health insurance) covering more than 28% of the population allocate only 1% of their annual expenditures which indicate a low insurance support of the services.[56]

Different studies in Iran have proposed strategies to deal with inequality in utilization of dental services. The common items include designing and development of basic and complementary health insurance programs to cover dental costs and allocate more public resources to the dental services and performing preventive and educational programs.[57-60]

Study limitations

The articles used in this systematic review and meta-analysis had different qualities. Some studies have been performed in small cities and others in large cities, so studies were performed in local not in national level. Furthermore, the households with the best SES were compared with the worst SES in terms of childhood dental caries. This cannot indicate the real status of inequality in access to the dental services.

Conclusions

This study confirms inverse relationship between SES and dental caries. Hence, we can conclude that public and

governmental supports, insurance coverage, and Iran health network have not been able to improve utilization of dental services by low socio-economic groups. Therefore, it seems necessary to revise dental health services in favor of the poor.

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Conflicts of interest

There are no conflicts of interest.

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